969-98 Biopsy Negative Left Ventricular Dysfunction After Cardiac Transplantation: Outcome and Role of Enhanced Immunosuppression

Dennis McNamara, Thomas DiSalvo, Michael Mathier, Gus Vlahakes, James Southern, Marc Semigran, G. William Dec. *University of Pittsburgh Medical Center, Pittsburgh, PA; Massachusetts General Hospital, Boston, MA*

To evaluate the incidence and etiology of LV dysfunction (LVD) occurring without cellular rejection after cardiac transplantation (CT), we retrospectively reviewed all echocardiograms from 93 consecutive CT recipients at Massachusetts General Hospital. A decrease in LVEF to <0.45 in the absence of secondary causes occurred in 15 patients (pts) (13 M, 2 F). RV biopsies (bx) showed moderate cellular rejection (ISHLT grade 2 to 3A) in 4/15 patients; 3/4 pts improved following therapy with enhanced immunosuppression (ENIM).

Diagnostic studies in the 11 pts without cellular rejection included LV bx (5 pts) and immunofluorescence staining for vascular rejection (4 pts); all were negative. Coronary angiography was performed in 10/11 pts and revealed mild distal disease in 2 pts. These 2 pts died within four months of angiography, and had diffuse coronary artery disease (CAD) at autopsy. Change in LVEF over time in the 9 pts without CAD were:

	Initial (n = 9)	LVD (n = 9)	Current (survivors) (n = 6)
Months After CT	0.4 ± 0.3	8.3 ± 7.8	47.8 ± 15
LVEF	0.64 ± 0.07	0.31 ± 0.09	0.53 ± 0.09

LV function improved spontaneously in 1 pt. The remaining 8 pts received ENIM for presumed rejection. Therapy included solumedrol in 7/8 pts. OKT3 in 4/8 pts, and actinomycin 2/8 pts. LVEF improved in 5/8, but returned to initial baseline only in 2 pts; 3 pts died within 2 months of presentation, despite therapy.

In summary: 1. LV dysfunction, unexplained by cellular rejection or angiographic evidence of coronary disease, occurred in 10% of pts within 2 years of CT. 2. Despite negative histology, LVEF improved in 62% of these pts treated with enhanced immunosuppression.

969-99 Biocompatible Mechanical Left Ventricular Support: Potential Alternative to Transplantation

Valluvan Jeevanandam, Barbara Todd, Satoshi Furukawa, James McClurken, Abhi Pathak, Howard Eisen, Carol Fisher, V. Paul Addonizio. *Temple University, Philadelphia, PA*

Use of mechanical circulatory support has been limited by its associated bleeding and thrombotic complications. Blood contact with an artificial surface results in a well-deined pattern of hematologic alterations. The TCI HeartMate® left ventricular assist device (LVAD) is an implantable circulatory support pump currently used as a bridge to transplantation. Its textured blood contacting surfaces result in a formation of an adherent pseudoneointimal lining which eliminates the direct interaction of blood elements with the artificial surface. To determine if this biological lining could mitigate the stereotypical blood-synthetic surface interactions, we studied eight patients who underwent implantation at our institution over a 10 month period from 5/93 to 3/94. Seven of the 8 patients were bridged to transplantation. Three patients were transplanted within 10 days and one month data could not be obtained. Hemodynamic and hemostatic parameters (mean ± sd) were studied as follows:

	Pre-implant	POD 7	POD 28
Cardiac index (l/min/m^2)	1.8 ± 0.7	3.2 ± 0.4	3.1 ± 0.5
Systolic BP (mmHg)	75.9 ± 6.8	125.8 ± 9.7	130.4 ± 8.1
Hemoglobin (mg/dl)	7.4 ± 1.8	8.2 ± 1.6	9.6 ± 2.0
Plasma free hemoglobin (mg/dl)	15.4 ± 1.7	6.4 ± 2.3	6.8 ± 1.9
Prothrombin time (sec)	14.2 ± 1.1	13.4 ± 0.7	13.3 ± 0.7
Partial thromboplastin time (sec)	56.7 ± 15.9	31.8 ± 4.8	37.6 ± 11.9
Platelet count (×10^3/cu mm)	250 ± 81	269 ± 63	325 ± 37

In vitro platelet reactivity to the agonist ADP remained normal pre and post implantation. Average perioperative blood requirements included PRBC, 3.3 ± 1.3 units; platelets, 2.3 ± 4.5 units; fresh frozen plasma, 2 ± 1.9 units. No blood products were required after postoperative day 2.

We conclude that TCI LVAD support improves hemodynamics and can bridge patients in pre-implant cardiogenic shock to transplantation. Furthermore, no red cell destruction or hemostatic and thrombotic complications were observed despite one month of support without anticoagulation therapy. Therefore, as the donor shortage continues, LVADs with biocompatible surfaces may provide an alternative to cardiac transplantation.

969-100 Changing Profile of the Cardiac Donor

Malcolm V. Brock, Rinoo Shah, Kirk J. Fleischer, R. Scott Stuart, William A. Baumgartner, Duke E. Cameron. *The Johns Hopkins Medical Institutions, Baltimore, MD*

As the demand for organs for cardiac transplantation has increased, donor criteria have evolved. We reviewed the characteristics of 190 cardiac donors from 1983 to 1993 to identify trends in donor profile and to determine if recipient outcome were affected. Donors were divided into early (1983–1987; n = 86) and late (1988–1993; n = 104) groups according to operative era. While mean donor age has not changed significantly (24 ± 0.9 to 26 ± 1.3 years), the proportion of donors older than 40 years has increased from 1% (1/86) to 15% (16/104) ($p < 0.001$). Trauma was the cause of death in 93% (80/86) of the early group and 65% of the late group (68/104) ($p < 0.001$); in the total series, donors older than 40 years were less likely to have died from trauma (31%; 5/16) than younger donors (83%; 143/173) ($p = 0.001$). The proportion of out-of-state donors has fallen from 71% (61/86) to 27% (28/104) ($p < 0.001$), while the proportion of ethnic minorities increased from 10% (9/86) to 25% (26/104) ($p < 0.001$). There have been no significant changes in gender profile; males constituted 78% (67/86) of the early group and 72% (75/104) of the late group. Five year survival after transplant was not predicted by donor age, mode of donor death, recipient age, or recipient UNOS status. In summary, donors in the current era are more likely (1) to be older, (2) to be within the state, (3) to come from an ethnic minority, and (4) to have died from causes other than trauma when compared to donors from the earlier era.

970 Echo-Doppler: Miscellaneous Topics

Tuesday, March 21, 1995, 3:00 p.m.–5:00 p.m.
Ernest N. Morial Convention Center, Hall E
Presentation Hour: 3:00 p.m.–4:00 p.m.

970-1 Adverse Prognosis of an Unsuccessful Mitral Valve Repair Immediately Followed by Valve Replacement: Value of Echocardiography

Irene M. Hellemans, Els G. Pieper, Anita C.J. Ravelli, Johannes P.M. Hamer, Wybren Jaarsma, Emile C. Cheriex, Henry A. van Swieten, Cathinka H. Peels, Jan G.P. Tyssen, Cees A. Visser, ESMIR (Echocardiographic Selection of patients for Mitral valve Repair). *Interuniversity Cardiology Institute (ICIN), Utrecht, The Netherlands*

To determine the risk of an unsuccessful mitral valve repair followed by replacement we prospectively studied 180 patients (pts) who underwent mitral valve surgery because of severe regurgitation using univariate analysis of preoperative clinical, echocardiographic and surgical characteristics.

Clinical and echocardiographic risk factors for unsuccessful repair were: female gender (relative risk (RR) 2.56*), concomitant mitral stenosis (RR 4.63*), restricted leaflet mobility (RR 2.48*), normal left ventricular enddiastolic diameter (RR 3.42*) and prediction of a replacement by echo (RR 4.74*).

Surgical risk factors were: restricted leaflet mobility (RR 4.0*), concomitant mitral stenosis (RR 4.83*) and aneurysm of the left ventricle (RR 3.17*).

In 12 pts the result of the repair procedure was deemed unsatisfactory after visual inspection and in 9 pts the replacement procedure was carried out on the basis of intraoperative echo assessment of residual regurgitation. One year mortality of these 21 patients was 24% and the RR of death was 2.15* compared to primary replacement pts. (*$p < 0.005$)

Conclusions:

1. Risk factors for an unsuccessful repair can readily be identified by preoperative echocardiography and determination of gender.

2. Unsuccessful mitral valve repair followed by valve replacement during the same surgical procedure is related to a substantial one-year mortality.

970-2 Digitally Compressed Echocardiograms Offer Superior Image and Diagnostic Quality to Video Tape: Results of the Digital ERA (Echo Record Access) Study

Tom H. Karson, Shalabh Chandra, Richard C. Zepp, Nancy A. Obuchowski, Robert M. Hill, Aaron S. Waitz, J.P. Patten, James D. Thomas. *Cleveland Clinic Foundation, Cleveland, Ohio*

Routine use of digital echocardiography has many advantages but requires inordinate amounts of computer memory. Storing compressed images would reduce memory needs; however, image quality (IQ) and diagnostic quality (DQ) may suffer. To gather data from a wide variety of echo users, attendees of the 1994 American Society of Echocardiography Scientific Sessions were asked to participate in a study comparing the IQ and DQ of digital images against images digitized from video tape of the same structures.

Methods: Video and digital loops were presented in a random, blinded, side-by-side manner. The digital images were either uncompressed or JPEG compressed at a 10:1 or 20:1 ratio. 179 conference attendees participated (73 physicians (41%), 61 sonographers (34%) and 25% others) and compared 20 pairs of loops of grayscale images (5 different pathologies at 3 compressions, with 1 pair repeated). The pathologies used were: mitral valve vegetation (D1), posterior LV wall hypokinesis (D2), posterior mitral leaflet prolapse (D3), amyloidosis with Eustachian valve (D4), and mitral stenosis with spontaneous echo contrast (D5). Participants were asked to grade which image had better IQ and which had better DQ using a 5-point scale. Responses from only physicians and sonographers were used to assess DQ. *Results:* For all pathologies combined, the digital images have significantly better IQ and DQ (Wilcoxon Sign Rank (WSR), $p < 0.0001$ for each compression level). Similarly, for each individual pathology, the IQ is significantly better than the video at all levels of compression (WSR, $p < 0.0005$ for each compression and disease type). For DQ, all 5 pathologies tended to favor the digital images with D2–D4 teaching statistical significance. There is no significant differrence in IQ and DQ between uncompressed and compressed digital images—even at compression ratios of up to 20:1. (Friedman's test, IQ-p = 0.521, DQ-p = 0.252). *Conclusions:* Results from 179 observers indicate that diagnostic and image quality of JPEG compressed images (even at a 20:1 compression) are significantly better than video tape (the current standard). Furthermore, amongst the digital images there is no significant difference between uncompressed and 20:1 JPEG compressed images. Thus, archival of JPEG compressed digital images is superior to images stored on video tape.

970-3 Aortic Root Dilation in Marfan's Syndrome: Relationship to Outcome

Malcolm E. Legget, Trisha A. Unger, Corrine O'Sullivan, Robin L. Bennett, Todd Zwink, Catherine M. Otto, Peter H. Byers. *University of Washington, Seattle, WA*

In order to examine the incidence of aortic (Ao) complications in Marfan's syndrome, and the relationship of the rate of Ao root dilation to outcome, 89 subjects with definite Marfan's syndrome (49 males, 40 females; mean age 27 ± 13 year) were followed for a mean of 5 (range 0–19) years. Endpoints examined were death, ascending Ao dissection and Ao root replacement. At follow-up, 71 patients were alive with no Ao complications, 6 patients died (4 from ascending and 2 from descending Ao dissection), and 12 patients survived Ao root replacement (3 for ascending dissection and 9 for ascending Ao aneurysm). Five year actuarial survival was 93%, and event free survival was 78%.

Patients receiving beta blocker therapy for greater than 1 year (n = 28, Group I) were compared with those who never received beta blockers or who took them for less than 1 year (n = 55, Group II). Actuarial survival at 5 years was 100% in Group I and 90% in Group II ($p = 0.09$), but event free survival was 73% in Group I and 85% in Group II (p = NS).

Serial echocardiographic measurements of the Ao root were made in 50 adults. Mean Ao root dimension was 40 ± 9 mm (range 25–83 mm) at entry and was 44 ± 10 mm (range 30–83 mm) at follow-up. Mean rate of change of Ao root dimension was 1 (range −3–18 mm/yr). A comparison of those with and without Ao complications (mean ± 1 SD) is shown below:

	No event (n = 39)	Event (n = 11)	p value
Enrollment age (yrs)	33 ± 9	37 ± 10	NS
Initial Ao sinus (mm)	38 ± 5	48 ± 15	0.02
Follow-up Ao sinus (mm)	42 ± 6	58 ± 19	<0.0001
Δ Ao dimension/year	0.5 ± 1	4 ± 7	0.003

The rate of change in Ao sinus ratio (observed/predicted), normalized for age and BSA, also was greater in those with (0.13 ± 0.24) vs those without (0.004 ± 0.03) an event ($p = 0.006$). There was no significant difference in the rate of change of aortic sinus ratio between beta-blocker Groups I and II (0.04 vs −0.005, p = NS).

Conclusions: Medium term survival was good in this Marfan's cohort, although there was a significant rate of aortic complications. Those with adverse outcomes had greater aortic dimensions, both at baseline and follow-up, as well as more rapid aortic root dilation.

970-4 Echocardiographic and Doppler Study of Patients with Heat Stroke and Heat Exhaustion

L. Mimish, H. Al-Mansour, M. Shahid, L. Hatle. *King Faisal Specialist Hospital & Research Centre, Riyadh, Saudi Arabia*

Three groups of patients exposed to heat during pilgrimage season (29th May–2nd June 1993) were studied. Outdoor temperatures exceeded 45°C. Standard 2D-Echocardiographic views and Doppler recordings of mitral and tricuspid inflows, aortic, subclavian and hepatic venous flows were obtained with computed assessment of chamber volumes, diameters and cardiac output. The 1st Group (G1) consisted of 35 patients admitted with clinical picture of heat stroke to the cooling units and were studied acutely during cooling. Fifty three % were females and forty seven % males. They had a mean age of 58 ± 11 years and mean B.S.A. of 1.9 ± 0.2 m^2. The mean rectal temperature for this group was 41.7 ± 0.9°C. The 2nd Group (G2) consisted of 27 patients admitted with diagnosis of heat exhaustion, 85% were males and 15% females. Mean age was 47 ± 15 years and mean B.S.A. 1.8 ± 0.2 m^2. The mean rectal temperature was 38.7 ± 1.3°C. The 3rd Group (G3) consisted of 31 control patients exposed to heat but without the above diagnoses. Eighty four % were males and 16% females with mean age of 38 ± 15 years and mean B.S.A. OF 1.7 ± 0.1%m^2, mean rectal temperature was 37.1 ± 0.6°C.

Findings: Cardiac output in G1 (8.2 l/min), was significantly higher than in G2 (6.4 l/min) ($P = 0.002$). Both significantly higher than in G3 (4.9 l/min) ($P = 0.0000$ and $P = 0.0005$ respectively). Left ventricular end systolic volumes were smaller in G1 (25.4 ml) compared to G2 (33.8 ml) $P = 0.04$ and G3 (52 ml) $P < 0.0001$. Mean heart rate (HR) and systolic blond pressure (BP) were 119 ± 24/min and 76 ± 25 mmHg for G1 97 ± 16/min and 102 ± 18 mmHg for G2 73 ± 11/min and 92 ± 16 mmHg for G3.

We conclude that haemodynamic changes in severe heat exposure reflect a hyperdynamic circulation in most of the patients with vasodilation of relative hypovolemia more pronounced in patients with heat stroke compared to heat exhaustion patients.

970-5 Echocardiographic Assessment of Left Ventricular Contractility During Prolonged Head-up Tilt in Patients with Neurally Mediated Syncope

Jürgen Hoffmann, Wolfram Grimm, Michael Degenhardt, Andreas Wirths, Bernhard Maisch. *Philipps-University Marburg, Germany*

The cause of head-up tilt (HUT) induced syncope is thought to be an inappropriate Bezold-Jarisch reflex resulting in a paradoxical chronotropic and/or vasomotor response to sympathetic stimulation after HUT induced decrease in left ventricular volume. If this was uniformly true, left ventricular hypercontractility should always precede HUT induced syncope. To test this hypothesis, we analyzed fractional left ventricular shortening (FS) throughout prolonged head-up tilt in 10 patients with HUT induced syncope and in a control group of 10 healthy volunteers without HUT induced syncope by two-dimensional echocardiography. HUT was performed at 60° for 45 min with foot plate support ("Westminster-Protocol"). No provocative maneuvers such as Isoprel infusion or carotid sinus massage were used. Hypercontractility in pts with HUT induced syncope was considered to be present if FS increased more than 20% during tilt compared to FS measured in the supine position.

Results: Hypercontractility during HUT was not observed in any of the 10 healthy volunteers without neurally mediated syncope (FS in the supine position was 34 ± 3% and did not change significantly during HUT). Hypercontractility preceded syncope in 5 of 10 pts with HUT induced syncope (FS supine: 31.6 ± 3%; FS shortly before syncope: 39.6 ± 4%, $p < 0.05$). In the remaining 5 patients with HUT induced syncope FS did not increase shortly before syncope (FS supine: 33.2 ± 3.4%; FS shortly before HUT induced syncope: 32.6 ± 1.7%, p = NS.).

Conclusions: Presence and absence of left ventricular hypercontractility before HUT induced syncope in 50% of our study patients suggest that the Bezold Jarisch reflex is not the only mechanism of neurally mediated syncope.

970-6 In Vivo Studies of Aortic Stenosis: Role of Inertial and Viscous Forces in Doppler/Catheter Discrepancies

Edward G. Cape, Lilliam M. Valdes-Cruz, Isumi Yamada, Michael D. VanAuker, Michael Jones. *University of Pittsburgh, PA; NHLBI-LAMS, Bethesda, MD*

In previous studies *in vitro* we have used a Reynolds number approach to analyze second order effects on pressure recovery distal to stenosis. It was shown that two fundamentally different effects, viscous losses and turbulent dissipation, can control the basic overestimation due to pressure recovery at both ends of the Reynolds number scale. Having quantified this effect in vitro, this study attempted to reconcile Doppler and catheter gradients across aortic stenosis *in vivo*. *Methods:* In 4 sheep with surgically created aortic stenosis, 30 hemodynamic states were studied (4–11 per sheep) using Millar transducers in the LV and Aorta (peak PG ranged 3–150 mmHg). A Vingmed 775 interfaced to a computer was used to measure CW velocities simultaneously with catheter recordings. *Results:* Instantaneous Doppler peak gradient correlated with catheter instantaneous gradient throughout the range of baseline and stenotic conditions ($r = 0.973$, SEE= 8.7 mmHg), but Doppler overestimated cath gradient (up to 70%) for all stenotic valve conditions by an average of 17%. Plotting overestimation versus Reynolds number revealed a second order profile of the shape derived in vitro. Correction of Doppler gradients using this parabolic factor reduced average overestimation from 17% to 1.5%. *Conclusions:* Overestimation due to pressure recovery is basic to aortic stenosis, but this overestimation can be partially canceled by two apparently unrelated effects: viscous effects and turbulent